REMARKS

Reconsideration and allowance are respectfully requested.

The dependency of claim 32 has been corrected and the informalities in the claims noted in the Office action have also been corrected so that it is now believed that all of the pending claims are in compliance with Section 112.

In the action, the original claims stand rejected under Section 103 over Owen et al in view of Aubert and Hettiarachchi et al. In response to the outstanding rejection, claims 1, 14 and 24 have been amended to emphasize significant features that are not found in the references either alone or as combined by the Examiner. Specifically, claims 1, 14 and 24, the independent claims in this case, now describe that the vibration excitation means is an actuator coupled to one of the clamping means through a drive arm with the actuator and drive arm positioned to one side of the first and second clamping means to apply the high cycle load transversely to the low cycle load. Further, these claims now recite that the stiffness of the drive member is selected so that the mass of the drive member and actuator have a natural resonant frequency close to the resonant frequency of the specimen being tested.

In contrast, in Owen et al., both the high cycle load and the low cycle load are applied in the same direction, that is, longitudinally of the specimen shown in Figure 2. There is simply nothing in this reference teaching or even suggesting the application of both a transverse load of any type to the specimen as well as a primary load which is generally axial. In the present invention, the application of a transverse load will induce bending in the specimen. This is of high interest particularly where the specimen is a compressor, turbine or fan blade of a jet engine. In Owen et al, there is no suggestion of any testing of a blade of any kind so that there is no basis for modifying any of the teachings of Owen et al so that it could achieve bending of the specimen under any circumstances. Moreover, there is no suggestion of selecting the stiffness of the drive arm and

actuator so that the mass of the these members have a natural resonant frequency close to the resonant frequency of the specimen. Moreover, the presence of two vibration modes enables improved matching of the actuator properties and enables the use of an electromechanical actuator above its designed frequency range and also allows the use of a piezoelectric actuator to be operated below its designed frequency range to induce a high amplitude vibration. In addition, Owen et al intend to test a material for its properties as opposed to an actual component. A further difference resides in the fact that the clamping means of the present invention are fixed, that is they do not move relative to the specimen. Thus, there are separate resonances of the actuator and the arm and the specimen with the clamping means defining the nodes for the vibration. Owen et al has their clamping means movable.

Both Aubert and Hettiarachchi relate to testing for crack propagation and add nothing to Owen et al. in terms of the structure now defined in the claims.

The French patent No. 680003A, cited by the applicant, is of interest in that it discloses a transverse as well as an axial loading but does not appear to address the stiffness and mass of the drive member and actuator and the resonant frequency of these elements relative to that of the specimen and thus is no more pertinent than Owen et al in view of the amendments submitted above.

In view of the foregoing, a favorable action is deemed warranted and the same is respectfully solicited.

Respectfully submitted,

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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE IN A SPECIFICATION

Please delete the paragraph at p. 5 line 30 and bridging over to p. 6 line 22 and insert the following:

The present invention also provides a device for fatigue testing of materials comprising a frame, first and second clamping means for holding a specimen to be tested, mounting means to mount the first and second clamping means on the frame, the mounting means vibrationally isolating the first and second clamping means from the frame, means to move at least one of the first and second clamping means to apply in operation a low cycle load on the specimen, means to measure the low cycle load, electrical insulating means to electrically insulate the frame from the specimen, vibration excitation means acoustically coupled to one of the first and second clamping means to apply in operation a high cycle load on the specimen, means to measure the high cycle load, detector means to detect vibration of the specimen and to produce an electrical signal, control means arranged to receive the electrical signal, the control means determining the resonant frequency of the specimen from the electrical signal and sending a signal to the vibration excitation means to maintain the high cycle load at the resonant frequency of the specimen, probes [are] being provided on the specimen in operation and [are] being arranged to produce a second electrical signal, means to supply an electrical current through the specimen, means to determine crack growth rate arranged to receive the second electrical signal and to determine the rate of crack growth in the specimen and/or determining the life of the specimen to failure.

Please delete the paragraph at p. 14, lines 1-27 and insert the following:

In a further method of operation to fatigue test specimen 12 [.], [The] the main control unit 42 also analyses the electrical signals to determine the

amplitude of vibration of the specimen 12. The main control unit 42 then sends further signals to the control unit 50 and/or the waveform generator 54 to maintain the frequency of vibration of the specimen 12 at its resonant frequency to maintain the amplitude of vibration of the specimen 12 at a predetermined amplitude until the specimen 12 fractures or fails completely. The main control unit 42 determines the amount of energy required to vibrate the specimen 12 at the predetermined amplitude of vibration at the resonant frequency, particularly in a bending mode vibration. It is possible to provide coatings of different damping materials or provide different damping treatments on identical specimens 12 to determine which damping material or damping treatment provides the most damping and/or to rank the damping materials and damping treatments in order of increasing damping coefficient. This is achieved by comparing the amount of energy required to vibrate the specimens 12 at the predetermined amplitude of vibration at the resonant frequency. This is particularly beneficial for determining suitable damping materials for fan blades, compressor blades or turbine blades. Also by testing this specimens 12 until they fail it is possible to determine the effect of the damping coating, or damping treatment, on the fatigue strength [of] <u>or</u> fatigue life of the specimen.

Please delete the paragraph at p. 14 beginning at line 28 and bridging over to p. 15 line 3 and insert the following:

The low cycle load applied may be a tensile load or a compressive load. The high cycle load may be a torsion load or a bending load. The leaf springs of the mounting means may be redesigned to have low torsional stiffness to allow testing of the torsional modes of the specimen. A torsional load is applied by adjusting the position of the shaker. In this case the shaker is mounted [of] <u>off</u> axis to apply a load to the second clamping means and a second shaker may be used to cancel the direct load applied to the second clamping means.

IN THE CLAIMS

Please cancel claims 4, 6, 27 and 29.

Please amend claim 1, 14 and 24 as follows:

(amended) 1. A device for fatigue testing of materials comprising a frame, first and second clamping means for holding a specimen to be tested, mounting means to mount the first and second clamping means on the frame, the mounting means vibrationally isolating the first and second clamping means from the frame, means to move at least one of the first and second clamping means to apply in [operation] use a low cycle load on the specimen in an axial direction, means to measure the low cycle load, vibration excitation means acoustically coupled to one of the first and second clamping means to apply in [operation] use a high cycle load on the specimen, means to measure the high cycle load, detector means to detect vibration of the specimen and to produce an electrical signal, control means [arranged] to receive the electrical signal, the control means determining the resonant frequency of the specimen from the electrical signal and sending a signal to the vibration excitation means to maintain the high cycle load at the resonant frequency of the specimen and means to store data of the test, said vibration excitation means comprising an actuator, said actuator being acoustically coupled to one of the first and second clamping means through a drive member comprising a drive arm and said actuator and said drive arm being located to one side of the said one of the first and second clamping means to apply the high cycle load transversely to the low cycle load, said drive member having a stiffness, said stiffness of the drive member being such that the mass of the drive member and actuator have a natural resonant frequency close to the resonant frequency of the specimen .

(Amended) 14. A method of fatigue testing of materials using a device comprising a frame, first and second clamping means for holding a specimen to be tested, mounting means to mount the first and second clamping means on the frame, the mounting means vibrationally isolating the first and second clamping means from the frame, means to move at least one of the first and second

clamping means to apply in operation a low cycle load on the specimen in an axial direction, means to measure in the low cycle load to, electrical insulating means to eat electrically insulate the frame from the specimen, vibration excitation means acoustically coupled to one of the first and second clamping means to apply in operation a high cycle load on the specimen, said vibration excitation means comprising an actuator, said actuator being acoustically coupled to one of the first and second clamping means through a drive member comprising a drive arm and said actuator and said drive arm being located to one side of the said one of the first and second clamping means to apply the high cycle load transversely to the low cycle load, said drive member having a stiffness, said stiffness of the drive member being such that the mass of the drive member and actuator had a natural resonant frequency close to the resonant frequency of the specimen , means to measure the high cycle load, detector means to detect vibration of the specimen and to produce an electrical signal, control means arranged to receive the electrical signal, the control means determining the resonant frequency of the specimen from the electrical signal and sending a signal to the vibration excitation means to maintain the high cycle load at the resonant frequency of the specimen and means to store data of the test, the method comprising the steps of:

(a) applying one of a low cycle load [and/or] and a high cycle load to the specimen,

(b) maintaining the vibration of the specimen at its resonant frequency,

(c) detecting a drop in the resonant frequency of the specimen indicative of the initiation of a crack in the specimen,

(d) stopping the test and locating the crack,

(e) attaching probes to the specimen at each side of crack, the probes [are] being arranged to produce a second electrical signal,

(f) supplying an electrical current through the specimen,

(g) resuming the test and maintaining the vibration of the specimen at its resonant frequency until failure of the specimen occurs,

(h) determining the rate of crack growth in the specimen from the second

electrical signal [and/or] or determining the life of the specimen to failure.

(Amended) 24. A device for fatigue testing of materials comprising a frame, first and second clamping means for holding a specimen to be tested, mounting means to mount the first and second clamping means on the frame, the mounting means vibrationally isolating the first and second clamping means from the frame, means to move at least one of the first and second clamping means to apply in operation a low cycle load on the specimen, means to measure the low cycle load, electrical insulating means to electrically insulate the frame from the specimen, vibration excitation means acoustically coupled to one of the first and second clamping means to apply in operation a high cycle load on the specimen, said vibration excitation means comprising an actuator, said actuator being acoustically coupled to one of the first and second clamping means through a drive member comprising a drive arm and said actuator and said drive arm being located to one side of the said one of the first and second clamping means to apply the high cycle load transversely to the low cycle load, said drive member having a stiffness, said stiffness of the drive member being such that the mass of the drive member and actuator have a natural resonant frequency close to the resonant frequency of the specimen, means to measure the high cycle load, detector means to detect vibration of the specimen and to produce an electrical signal, control means arranged to receive the electrical signal, the control means determining the resonant frequency of the specimen from the electrical signal and sending a signal to the vibration excitation means to maintain the high cycle load at the resonant frequency of the specimen, probes [are] being provided on the specimen in [operation] use and [are arranged] to produce a second electrical signal, means to supply an electrical current through the specimen, means to determine crack growth rate arranged to receive the second electrical signal and to determine the rate of crack growth in the specimen [and/or] or determining the life of the specimen to failure .

Please amend claims 5, 7, 28, 30 and 32 as follows:

(amended) 5. A device is claimed in claim [4] 1 wherein the actuator is

arranged to generate frequencies in the range of 50Hz to 5kHz.

(Amended) 7. A device is claimed in claim [4] 1 wherein the actuator is an electrodynamic, piezoelectric or a magnetostrictive actuator.

(Amended) 9. A device as claimed in claim 8 wherein the heating means comprises a furnace [arranged to surround] surrounding the specimen.

(Amended) 28. A device is claimed in claim [27] 24 wherein the actuator [is arranged to generate] generates frequencies in the range 50Hz to 5kHz.

(Amended) 30. A device is claimed in claim [27] 24 wherein the actuator is an electrodynamic, piezoelectric or a magnetostrictive actuator.

(Amended) 32. A device as claimed in claim [37] 31 wherein the heating means comprises a furnace [arranged to surround] surrounding the specimen.